

How to Manage Burns in Primary Care

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SUMMARY

Burns are common injuries; more than 200 000 occur in Canada annually. Nearly all burn injuries can be managed on an outpatient basis. Appropriate treatment depends on burn depth, extent, and location. Special types of burns, such as chemical, tar, and electrical injuries, need specific management strategies. Prevention through education is important to reduce the incidence of burns.

RÉSUMÉ

Les brûlures sont courantes. On en compte plus de 200 000 par année au Canada. On peut traiter en clinique externe la plupart de ces blessures. Le traitement approprié est fonction du degré de la brûlure, de son extension et de sa localisation. Certains types spécifiques de brûlures, telles les brûlures chimiques, électriques et par goudron, nécessitent des stratégies thérapeutiques spécifiques. L'éducation préventive est importante pour réduire l'incidence des brûlures.

Can Fam Physician 1993;39:2394-2400.

ABURN IS ONE OF THE MOST devastating injuries a patient can experience. Burn injuries are second only to motor vehicle accidents as accidental causes of death. Multiple organ systems (skin, lungs, eyes, mucous membranes, gastrointestinal, renal, and immunological) are affected by serious burns, and patients suffer loss of function and disfiguring scars.^{1,2}

Approximately 200 000 Canadians sustain a burn injury each year; 95% of these injuries can be treated on an outpatient basis.³ Both undertreatment and overtreatment of minor burns results in pain and prolonged morbidity, infection, delayed wound healing, and poor functional and aesthetic results. The main goals of managing outpatient burns are to facilitate patient comfort, wound healing, and rapid rehabilitation.⁴

Epidemiology

In Canada and the United States, approximately 1% of the population is seen by a physician each year for a burn injury.² Smoke inhalation is the most com-

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mon cause of death from major burns and occurs in 30% of such injuries. If the patient survives the first few days, the most common cause of death becomes infection, including burn wound sepsis and pneumonia.^{1,2}

Although building fires account for less than 5% of burn admissions, they are responsible for 45% of burn deaths.⁵ Common causes include smoking, electrical sources, cooking, local heating units, and arson. In the United States fires due to smoking are responsible for 5000 burns, 2300 deaths, and \$300 million (US) in property damage each year.⁶ Two thirds of fire deaths occur at home, and 50% of these fires are caused by children.⁶ The incidence of fire injury is highest among those 18 to 25 years, but deaths from burn injury are more common among the very young and the elderly.⁶ Burn injuries to children are often caused by scalds, whereas among teens and adults flammable liquids are more often the culprits.⁵

The mortality in 1964 of a 50% body surface area burn was more than 50%; by 1984 this was reduced to less than 10%. The most significant advance in burn care responsible for this decrease was likely the development of specialized burn care teams and burn centres.^{5,7}

Evaluating the burn injury

A patient with a burn injury usually presents to the emergency department, and

the status of airway, breathing, and circulation need to be assessed immediately. The acute management of a major burn is beyond the scope of this article, but there are many excellent reviews on the subject.⁷⁻⁹ The severity of the burn must then be evaluated based on extent, depth, location, origin, patient's age, and comorbidity. This evaluation helps physicians determine whether to admit a patient to hospital or to treat as an outpatient.

Extent. The percentage of body surface area (BSA) burned is used to describe the extent of a burn injury. First-degree burns are not included when calculating BSA. To estimate the BSA involved in a burn injury, the "rule of nines" can be used for patients older than 10 years (*Figure 1*). It is also useful, especially for patchy burns, to remember that the patient's palm is 1% of the BSA.^{2,3} Children younger than 10 years have different body proportions, so a Lund-Bowder chart should be used to calculate BSA.¹⁰ These charts are available in most emergency departments and are also available for adults.

Depth. The depth of a burn is determined by temperature and duration of exposure. The skin can tolerate temperatures up to 40°C for long periods. Above this temperature, tissue destruction from protein coagulation begins, and it increases logarithmically with increasing temperature.⁷ Burns are categorized as first-, second-, third-, or fourth-degree (*Table 1*).

First-degree burns: Tissue destruction involves only the epidermis. There is typically pain and erythema that blanches to pressure but no blister formation. Systemic response is minimal or absent, and healing occurs in 3 to 4 days. First-degree burns are usually caused by sun (ultraviolet light) exposure, mild scalds, or flash burns from an explosion.²⁻⁴

Second-degree burns: Second-degree (partial thickness) burns are subdivided into superficial partial thickness and deep partial thickness. Superficial partial thickness burns (*Figure 2*) involve the epidermis and superficial dermis. Blister formation is common; if the blisters rupture or are removed, the wound is moist and erythematous. The burn is painful with intact sensation in the wound. These burns heal

by epithelialization from the adjacent unburned skin and intact skin appendages (hair follicles, sebaceous and sweat glands) in 2 to 3 weeks with minimal scarring. The usual causes of superficial partial thickness burns are scalds, flash burns, or brief contact with hot objects.²⁻⁴

Deep partial thickness burns involve the epidermis and most of the dermis. Some skin appendages and nerve endings are left intact. These burns often appear mottled with waxy white areas and red elements representing coagulated dermal vessels. The surface is dry with reduced sensation. Healing usually occurs spontaneously in 4 to 6 weeks; however, the epidermis is often unstable, leading to repeated breakdown and hypertrophic scarring. Contracture formation around joints is common. It is often difficult to distinguish deep partial thickness from full thickness (third-degree) burns initially. Two or 3 days sometimes elapse before the burn "declares" itself. These burns are commonly caused by flame, scalds, or hot grease.²⁻⁴ All large second- and third-degree burns have systemic effects, which are important for patient management but beyond the scope of this article.

Third-degree burns: Third-degree or full thickness burns (*Figure 3*) involve the epidermis and full thickness of the dermis, and varying amounts of the subcutaneous tissue. The wound appears white, tan, gray, brown, or red, and thrombosed blood vessels can be seen. The destroyed elasticity of the dermis gives the burn a leathery texture, and the wound is anesthetic. Third-degree burns are usually caused by flame, electricity, chemicals, or prolonged contact with a heat source.²⁻⁴

Fourth-degree burns: These burns are the same as third-degree burns, but involve deep structures, such as tendon, muscle, or bone.

Location. When evaluating a burn and deciding whether it merits admission to hospital, several critical areas of the body must be considered. These include the face, ears, eyes, hands, feet, and perineum. Burns that encircle a limb, the neck, or the chest must also be specially evaluated. The eschar (dead, coagulated skin) from a third-degree burn can cause vascular insufficiency or respiratory compromise.

Figure 1. Rule of nines for estimating body surface area burned:

Each upper limb is 9%, each lower limb 18%, the head and neck 9%, the back and buttocks 18%, and the chest and abdomen 18%.

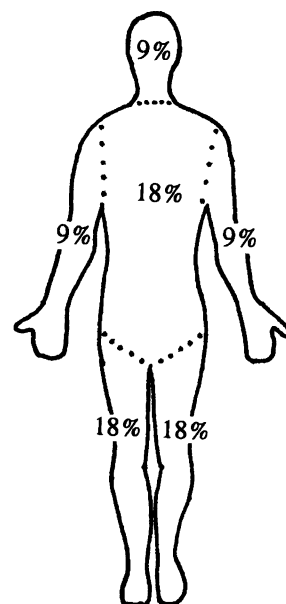


Table 1. Burn depth evaluation

| DEPTH | ANATOMY | APPEARANCE | SENSATION | SCARRING |
|---------------|--|---|------------------------------------|---|
| First-degree | Epidermis only | Erythema that blanches with pressure | Intact; burn mildly painful | None |
| Second-degree | | | | |
| • Superficial | Epidermis and superficial dermis; skin appendages intact | Blisters moist and erythematous underneath; blanches with pressure | Intact; burn painful | Unusual |
| • Deep | Epidermis and most of dermis; most skin appendages destroyed | Whitish with red elements, dry, waxy; does not blanch | Decreased; burn less painful | Usually occurs; could be hypertrophic; contractures |
| Third-degree | Epidermis, all of dermis, and skin appendages destroyed | White, red, tan, charred, thrombosed vessels; dry and leathery; does not blanch | Anesthetic; burn wound not painful | Present; could be hypertrophic; contractures |
| Fourth-degree | Same as for third-degree with tendon, bone, or muscle involved | Same as for third-degree | Same as for third-degree | Same as for third-degree |

The burn eschar is inelastic and causes constriction as the surrounding injured tissue becomes edematous. If this occurs, immediate referral for surgical evaluation is indicated.^{2,4,7}

Origin. Several types of burns require special consideration. Electrical burns can appear minor on the surface; however, often underlying muscle, nerve, and blood vessel damage requires expert evaluation. Cardiac arrhythmias can occur during the first 72 hours after injury and should be monitored.^{2,11} Chemical burns also can be more severe than expected from initial examination. These burns occasionally require very specific treatment for local and systemic disease.^{2,12} A final concern is whether the burn was an intentional injury. If child abuse or any other type of assault is suspected, the proper authorities should be involved and admission could be warranted. If the injury was self-inflicted, the patient requires psychiatric evaluation.

Age. Patients who are either very young or elderly need special consideration during burn evaluation. These age groups suffer a greater mortality than other age groups with similar burns.⁶ Also, the social circumstances of the patient often play an

important role in his or her ability to cope at home with the injury.

Comorbidity. Other injuries occurring at the time of the burn and concurrent unrelated illnesses should both be considered. Burn patients must always be evaluated carefully for the possibility of inhalation injury, especially if they have been trapped in an enclosed space, such as a building or car, during a fire. Patients should be examined for singed scalp hair, nasal hair, or beard; soot on the mucous membranes; and carbonaceous sputum. The patient could have a cough, wheeze, or difficulty breathing or swallowing.² Respiratory distress most often develops several hours after the burn and, if present immediately, can represent carbon monoxide poisoning or constricting eschar around the chest or neck.⁷ Any suggestion of inhalation injury is reason to admit a patient to hospital for observation.

Other trauma often accompanies burns and must be searched for. Falls are common in building fires and electrical burns, and spinal injury or fractures should be ruled out. Tetanus status must be ascertained, and toxoid with or without tetanus immune globulin should be given when indicated. The patient's medical history, including cardiovascular, pulmonary,

renal, and endocrine disease, must be assessed for how it could affect current management. All medications and allergies should be noted.

Whom to admit. Once this evaluation is complete, a treatment plan is formulated. The American Burn Association's grading system for determining injury severity can be used as a guide when deciding whether a patient requires admission. Second-degree burns of greater than 15% BSA in adults or 10% in children, and third-degree burns greater than 2% BSA in either should be admitted. Special consideration is also given to patients who do not necessarily meet these requirements but have a burn in a critical area, are at the extremes of age, have significant comorbidity, or have special social circumstances.⁴

Treatment

The initial management of a burn is always to remove the source of injury (extinguish flames, remove source of heat or electricity, wash off chemicals). Burn wounds should be cooled to stop progression of the burn and to decrease pain. This is done by submerging the burn in cool water or applying cool saline compresses, remembering to avoid hypothermia in patients with large burns.^{2,3,13} Constricting clothing and jewelry should be removed, the burn covered with clean cloth or gauze, and the patient transported to an appropriate centre for evaluation of the burn.

Depth of burn. *First-degree burns:* First-degree burns require minimal treatment. A mild oral analgesic and moisturizer to be applied to the burn are usually sufficient. There is no benefit to applying a dressing.²

Second-degree burns: All partial thickness burns should be cleansed using water and a mild soap after the patient has been given adequate analgesia. The burn should then be debrided, removing necrotic tissue, ruptured blisters, and blisters filled with cloudy fluid.¹³ Managing clean intact blisters is controversial,⁴ but we suggest leaving these alone unless imminent rupture appears likely.

Topical chemoprophylaxis should not be used routinely on small burns but is

useful for large burns to reduce the incidence of burn wound sepsis. The most common agent used is silver sulfadiazine (SSD) applied twice daily, which has broad antimicrobial coverage and penetrates burn eschar. However, allergic reactions to the sulfa component can occur; it is irritating to mucous membranes; it can breed resistant strains of bacteria; and it is contraindicated during pregnancy and for infants younger than 2 months. Use of SSD has also been shown to delay wound



Figure 2. Superficial partial thickness (second-degree) burn to a hand: *The wound is moist and erythematous with blister formation.*

.....
healing, decrease leukocyte chemotaxis, and cause a transient leukopenia in 10% of cases.^{2,3,6}

A dressing is then applied. The burn dressing provides a clean and moist environment, which promotes healing, reduces trauma to the wound, allows drainage, and increases patient comfort. The first dressing layer consists of a petroleum jelly-impregnated nonadherent gauze (some authors suggest using a polymyxin B ointment in addition). A second layer of saline-soaked gauze to dry gauze and a final layer of bandage wrapping (being certain not to overconstrict) completes the dressing.^{2,4}

The dressings should be changed twice daily for larger burns and daily for smaller burns. The dressings are removed after soaking in water. The burns are then washed gently with water and soap and patted dry with a clean cloth.

Dressing changes are done initially at the hospital, an outpatient clinic, or the family physician's office, depending on the extent of the burn and the patient's analgesia requirements. After some basic teaching, the patient, the patient's family,



Figure 3. Full thickness (third-degree) burn to a breast: Tan, leathery eschar covers the wound.

..... or a visiting nurse can often change dressings at home.²

Range of motion exercises should be started early for any burn involving a joint area, and referral to a physiotherapist familiar with burn rehabilitation is often indicated.⁴ Systemic antibiotics should not be given routinely except when endocarditis prophylaxis is required. The wounds should be closely monitored for signs of infection. Initially Gram-positive organisms (especially *Streptococcus* species) tend to proliferate in the burn wound, but by day 5 Gram-negative organisms (especially *Pseudomonas aeruginosa*) predominate.² If

burn wound infection is suspected, it is best managed by referral to a plastic surgeon.

Dressings are continued until full healing occurs. After this, moisturizers are applied (burned skin tends to be dry and itchy for several months), and the patient is instructed to keep the burned area out of the sun for 1 year.^{3,4} If the wound does not appear to be healed by 3 weeks after the injury, referral to a plastic surgeon is indicated. Excision and skin grafting will likely be necessary to avoid delayed wound healing, wound breakdown, and hypertrophic scarring.^{3,4}

Third-degree burns: Third-degree burns are initially treated like partial thickness burns. The wound is cleansed and debrided, and dressings are changed twice daily using SSD cream. Spontaneous healing of third-degree burns is slow and functionally and aesthetically inadequate, so all but the smallest (less than 2 cm) wounds require excision and grafting by a plastic surgeon.^{3,4}

Fourth-degree burns: These are managed identically to third-degree burns with early referral to an experienced burn surgeon.

Critical areas. Burns to critical areas of the body usually require referral for expert management.

Face: Burns to the face often become very edematous after 24 hours. These burns should not be treated with SSD or dressings but rather with twice daily washing and application of polymyxin B ointment.^{3,4}

Ears: Superficial burns to the ears should be treated identically to burns to the face. Deeper burns require SSD or mafenide cream and dressings, avoiding any pressure over the burn that could lead to chondritis.^{3,4}

Eyes: A fluorescein slitlamp examination should be done with a suspected eye injury. A minor burn will resemble an abrasion and should be irrigated and treated with antibiotic ointment and patching. Any injury not fully healed in 48 hours, or any major injury, should be referred to an ophthalmologist.⁴

Hands: Burns to the hands can easily cause vascular compromise, so encircling eschar must be attended to. The wounds should be treated as outlined above, depending on depth, and each finger must

be dressed individually to prevent maceration. The hand should be kept elevated to improve comfort, edema, and healing. Early range of motion exercises are vital, and referrals to a physiotherapist and occupational therapist are often indicated to maintain mobility. Splinting is required to prevent contracture formation.^{3,4}

Feet: These injuries should be treated much like hand burns. Early ambulation is encouraged after healing, with a tensor bandage applied to the feet.^{3,4}

Perineum: Burns to the perineum should be treated as outlined above, depending on depth. It is often wise to observe these patients for 48 hours for the development of urinary obstruction secondary to edema, which can require catheterization.⁴

Special burns. Chemical burns: All chemical burns should be irrigated with water or saline for at least 20 minutes. Neutralizing agents should be avoided because they produce exothermic reactions, which can worsen the burn. The burns are then treated as outlined above, keeping in mind possible systemic toxicities, such as phenol burns causing renal failure. Hydrofluoric acid burns require additional subcutaneous injections of 10% calcium gluconate around the burn to precipitate the fluoride ion. This limits progression of the burn and decreases pain significantly.^{3,12}

Tar burns: Tar covers and adheres to the burn wound. Removal is very traumatic to the wound and should be avoided, but the tar should be cooled immediately with water. Application of copious amounts of polymyxin B ointment or special industrial solvents will emulsify and remove the tar over several days.^{3,12}

Electrical burns: The first step in managing an electrical burn is safe removal of the patient from the source of current and resuscitation if injuries are life-threatening. These patients should be monitored for particular problems, such as arrhythmias or compartment syndromes requiring fasciotomies. Renal failure (acute tubular necrosis) from myoglobinuria can occur, requiring high volumes of IV fluids and occasionally mannitol or sodium bicarbonate diuresis. Entrance, exit, and arc (across the axilla, antecubital fossa, or popliteal fossa) wounds must be searched

for. Often the burn injury to the skin is quite small; however, there can be a large underlying area of necrotic muscle and bone, requiring urgent surgery. Associated injuries are common and include fractures, neuropathies, central nervous system symptoms, and vascular injury.^{11,13}

Scarring. All burns should be observed for at least 6 weeks for hypertrophic scarring. These red, thick, raised, and often itchy or painful scars are common in deep partial thickness and full thickness burns. Management of hypertrophic scars consists of compression garments for 6 months to 2 years and occasionally steroid injections into small scars. Scarring across joints can cause serious contractures. These are best managed by referral for splinting and surgical evaluation.^{3,4}

Education and prevention

The optimal management of burn injuries is to prevent their occurrence. Long exposure to sunlight should be discouraged and the use of sunscreen encouraged. Electrical appliances should be kept in good condition, with inspection and proper maintenance when indicated.

If there are children in the house, the water heater should be set at a temperature no higher than 50°C, and all hot pots and pans should be out of reach with handles turned inward. Children must be taught not to play with lighters, matches, or other potential sources of fire.

All homes and buildings should be equipped with functioning smoke detectors, and smoking in bed should be strongly discouraged. Flammable liquids, such as gasoline or lighting fluid, should never be added to warm machinery, burning fires, or hot barbecues. By educating the public with simple strategies such as these, a great deal of human morbidity and property damage can be avoided.^{2,6} ■

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BACTERICIDAL

Macrofantin[®] nitrofurantoin macrocrystals

THERAPEUTIC CLASSIFICATION: Urinary Tract Antibacterial. **ACTIONS AND CLINICAL PHARMACOLOGY:** MACRODANTIN is a larger crystal form of nitrofurantoin. The absorption of MACRODANTIN is slower and its urinary excretion somewhat less when compared to nitrofurantoin tablets. At therapeutic doses, low drug concentrations are observed in blood, with therapeutic concentrations achieved only in the urine. A number of patients who cannot tolerate nitrofurantoin tablets are able to take MACRODANTIN capsules without nausea. MACRODANTIN (nitrofurantoin) is bactericidal in urine at therapeutic doses. Its mode of action includes inhibition of bacterial protein synthesis, RNA/DNA synthesis, and energy metabolism. Bacteria develop only a limited resistance to furan derivatives clinically. **INDICATIONS AND CLINICAL USE:** MACRODANTIN is indicated for the treatment of urinary tract infections, e.g. pyelitis, cystitis, when due to susceptible strains of *E. coli*, enterococci, *S. aureus* and certain susceptible strains of *Klebsiella* species, *Enterobacter* species, and *Proteus* species. It is not indicated for treatment of associated renal cortical or perinephric abscesses. Nitrofurantoin is not indicated for therapy of any systemic infections or for use in prostatitis. **CONTRAINDICATIONS:** Anuria, oliguria, or significant impairment of renal function (creatinine clearance under 60 mL per minute or clinically significant elevated serum creatinine) are contraindications to therapy with this drug. Treatment of this type of patient carries an increased risk of toxicity because of impaired excretion of the drug. For the same reason, this drug is much less effective under these circumstances. The drug is contraindicated in pregnant patients at term (during labour and delivery), and in infants under one month of age because of the possibility of hemolytic anemia in the fetus or the newborn infant due to their immature erythrocyte enzyme systems (glutathione instability). The drug is also contraindicated in those patients with known hypersensitivity to MACRODANTIN and other nitrofurantoin preparations. **WARNINGS:** Acute, subacute and chronic pulmonary reactions have been observed in patients treated with nitrofurantoin products. (SEE ADVERSE REACTIONS). If these reactions occur, the drug should be withdrawn and appropriate measures taken. Reports have cited pulmonary reactions as a contributing cause of death. Chronic pulmonary reactions (diffuse interstitial pneumonitis or pulmonary fibrosis, or both) can develop insidiously. These reactions occur rarely and generally in patients receiving therapy for six months or longer. Close monitoring of the pulmonary condition of patients receiving long-term therapy is warranted and requires that the benefits of therapy be weighed against potential risks. (SEE ADVERSE REACTIONS) Hepatic reactions, including hepatitis, cholestatic jaundice and chronic active hepatitis, occur rarely. Fatalities have been reported. The onset of chronic active hepatitis may be insidious, and patients should be monitored periodically for changes in liver function. If hepatitis occurs the drug should be withdrawn immediately and appropriate measures taken. Peripheral neuropathy may occur with MACRODANTIN therapy; this may become severe or irreversible. Fatalities have been reported. Predisposing conditions such as renal impairment (creatinine clearance under 60 mL per minute or clinically significant elevated serum creatinine), anemia, diabetes, electrolyte imbalance, vitamin B deficiency, and debilitating disease may enhance such occurrence. Patients receiving long-term therapy should be monitored periodically for changes in renal function. If numbness or tingling occurs, discontinue use. Cases of hemolytic anemia of the primaquine sensitivity type have been induced by MACRODANTIN. The hemolysis appears to be linked to a glucose-6-phosphate dehydrogenase deficiency in the red blood cells of the affected patients. This deficiency is found in 10 percent of Blacks and a small percentage of ethnic groups of Mediterranean and Near-Eastern origin. Any sign of hemolysis is an indication to discontinue the drug. Hemolysis ceases when the drug is withdrawn. *Pseudomonas* is the organism most commonly implicated in superinfections in patients with MACRODANTIN. **PRECAUTIONS: Drug Interactions:** Magnesium trisilicate, when administered concomitantly with MACRODANTIN reduces both the rate and extent of absorption. The mechanism for this interaction probably is adsorption of drug onto the surface of magnesium trisilicate. MACRODANTIN should not be given along with drugs which may produce impaired renal function. Uricosuric drugs, such as probenecid and sulfinpyrazone, may inhibit renal tubular secretion of MACRODANTIN. The resulting increase in serum levels may increase toxicity and the decreased urinary levels could lessen its efficacy as a urinary tract antibacterial. **Drug/Laboratory Test Interactions:** As a result of administration of nitrofurantoin, a false-positive reaction for glucose in the urine may occur. This has been observed with Benedict's and Fehling's solution but not with the glucose enzymatic test. **Impairment of Fertility:** The administration of high doses of nitrofurantoin to male rats causes temporary spermatogenic arrest, which is reversible on discontinuing the drug. Doses of 10 mg/kg or greater in healthy human males may, in certain unpredictable instances, produce slight to moderate spermatogenic arrest with a decrease in sperm count. **Pregnancy:** The safety of MACRODANTIN during pregnancy and lactation has not been established. Use of this drug in women of child-bearing potential requires that the anticipated benefit be weighed against the possible risks. **Labour and Delivery:** MACRODANTIN should not be given to women at term or to infants under one month of age. (SEE CONTRAINDICATIONS) **Nursing Mothers:** Nitrofurantoin has been detected in trace amounts in breast milk. Caution should be exercised when MACRODANTIN is

administered to a nursing woman, especially if the infant is known or suspected to have a glucose-6-phosphate dehydrogenase deficiency. **Pediatric Use:** MACRODANTIN is contraindicated in infants under one month of age. (SEE CONTRAINDICATIONS) **ADVERSE REACTIONS: Respiratory:** Chronic, subacute or acute pulmonary hypersensitivity reactions may occur. (SEE WARNINGS) Chronic pulmonary reactions are more likely to occur in patients who have been on continuous nitrofurantoin therapy for six months or longer. The insidious onset of malaise, dyspnea on exertion, cough, and altered pulmonary function are common manifestations. Radiologic and histologic findings of diffuse interstitial pneumonitis or fibrosis, or both, are also common manifestations of the chronic pulmonary reaction. Fever is rarely prominent. The severity of chronic pulmonary reactions and the degree of their resolution appear to be related to the duration of therapy after the first clinical signs appear. Pulmonary function may be permanently impaired even after cessation of nitrofurantoin therapy. The risk is greater when pulmonary reactions are not recognized early. In subacute reactions, fever and eosinophilia are observed less often than in the acute form. Upon cessation of therapy, recovery may take as long as several months. If the symptoms are not recognized as being drug related and nitrofurantoin is not withdrawn, symptoms may become more severe. Acute reactions are commonly manifested by fever, chills, cough, chest pain, dyspnea, pulmonary infiltration with consolidation and/or pleural effusion on x-ray, and eosinophilia. The acute reactions usually occur within the first week of treatment and are reversible with cessation of therapy. Resolution may be dramatic. **Gastrointestinal:** Anorexia, nausea and emesis are the most frequent reactions; abdominal pain and diarrhea occur less frequently. This dose-related toxicity can be minimized by reduction of dosage. **Hepatic:** Hepatic reactions, including hepatitis, chronic active hepatitis and cholestatic jaundice, occur rarely. (SEE WARNINGS) **Neurologic:** Peripheral neuropathy (SEE WARNINGS). Less frequent reactions of unknown causal relationship are nystagmus, vertigo, dizziness, asthenia, headache and drowsiness. **Dermatologic:** Exfoliative dermatitis and erythema multiforme (including Stevens-Johnson Syndrome) have been reported rarely. Transient alopecia has been reported. **Allergic Reactions:** Lupus-like syndrome associated with pulmonary reaction to nitrofurantoin has been reported. Also, angioedema, maculopapular, erythematous or eczematous eruptions, urticaria, rash and pruritus have occurred. Anaphylaxis, arthralgia, myalgia, drug fever, and chills have been reported. **Hematologic:** Agranulocytosis, leukopenia, granulocytopenia, hemolytic anemia, thrombocytopenia, glucose-6-phosphate dehydrogenase deficiency anemia, megaloblastic anemia, and eosinophilia have occurred. Cessation of therapy has generally returned the blood picture to normal. Aplastic anemia has been reported rarely. **Miscellaneous:** As with other antimicrobial agents, superinfections by resistant organisms, eg., *Pseudomonas*, may occur. However, these are limited to the genitourinary tract because suppression of normal bacterial flora does not occur elsewhere in the body. Nitrofurantoin may cause a rust-yellow to brown discolouration of the urine. Sialadenitis and pancreatitis have been reported. **DOSE AND ADMINISTRATION: DOSAGE Adults:** 50-100 mg four times a day. Children: Should be calculated on the basis of 5-7 mg/kg of body weight per 24 hours to be given in divided doses four times a day (contraindicated under one month). **ADMINISTRATION:** MACRODANTIN may be given with food or milk to further minimize gastric upset. Therapy should be continued for at least one week or for at least 3 days after sterility of the urine is obtained. Continued infection indicates the need for reevaluation. For long-term suppressive therapy in adults, a reduction of dosage to 50-100 mg once daily at bedtime may be adequate. See WARNINGS section regarding risks associated with long-term therapy. For long-term suppressive therapy in children, doses as low as 1 mg/kg per 24 hours, given in a single or in two divided doses, may be adequate. **AVAILABILITY:** MACRODANTIN is available in 25 mg, 50 mg and 100 mg capsules for oral administration. 100 mg: opaque, yellow capsules coded with 3 black bars and MACRODANTIN, 100 mg, 0149, 0009, bottles of 100's and 500's. 50 mg: opaque, yellow and white capsules coded with 2 black bars and MACRODANTIN, 50 mg, 0149, 0008, bottles of 100's and 500's. 25 mg: opaque, white capsules coded with 1 black bar and MACRODANTIN, 25 mg, 0149, 0007, bottles of 100.

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